A REPORT ON THE TROPHIC STATUS OF THE SOUTH BASIN OF LAKE WINNIPEG (1980 - 1982)

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INTRODUCTION

The Public Participation Program was initiated in 1978 in response to requests for water quality information by concerned cottage owners on many of the recreational lakes in Manitoba. Previous studies have shown that the enrichment (trophic) status of a lake can be estimated by the use of Secchi disc readings (transparency) and chlorophyll a concentrations (the green pigment in algae) which indicate water clarity and algal densities, respectively. The determination of the trophic status of lakes is vital to the classification of those lakes for management purposes, restoration, protection and site specific monitoring.

Volunteers are supplied with sampling kits which include a Secchi disc, a composite water sampler, one litre bottles, magnesium carbonate preservative and instructions. Participants are requested to take weekly Secchi disc measurements and samples during the ice free period of the year. Water samples are preserved and shipped to the Technical Services Laboratory in Winnipeg, where they are analyzed for chlorophyll a. Analyses of the chlorophyll a and Secchi disc results reveal the relative trophic status of each lake. Long term sampling over a number of years is useful in the detection of trends related to nutrient enrichment.

It is essential that a sampling program on a lake be continued over a period of five to ten years in order to determine if there is a trend toward accelerated enrichment. In many lakes, temporary degradation of water quality occurs during periods of extensive algal blooms. The fluctuation in algal populations occurs both seasonally and from year to year, and is caused by environmental factors such as sunlight and chemical and biological activity. Over the long term, however, definite increases in chlorophyll a would be indicative of accelerated enrichment (eutrophication) which could be induced by the addition of man generated nutrients.

Sources of nutrients are sink and laundry wastes and seepage from septic tank systems and pit privies. All lake users should be aware of the potential problems which can be caused by these sources of nutrients and that they can contribute to the impairment of recreational and aesthetic water quality. If, over the long term, it becomes apparent that man generated nutrients are contributing to accelerated eutrophication, then the sources would have to be identified and steps would have to be taken to minimize their effects.

This report includes a map or maps showing stations, weekly chlorophyll a and Secchi disc values, mean annual chlorophyll a and Secchi disc values and trophic state indices. The trophic state indices (0-100), developed by Carlson (1977), are derived from mean annual chlorophyll a and Secchi disc values.

NOTE: Water taken from lakes for domestic uses should be boiled or disinfected and, as is stated in the Public Health Act of Manitoba,

"All surface waters should be considered unsafe for domestic purposes unless boiled or otherwise disinfected..."

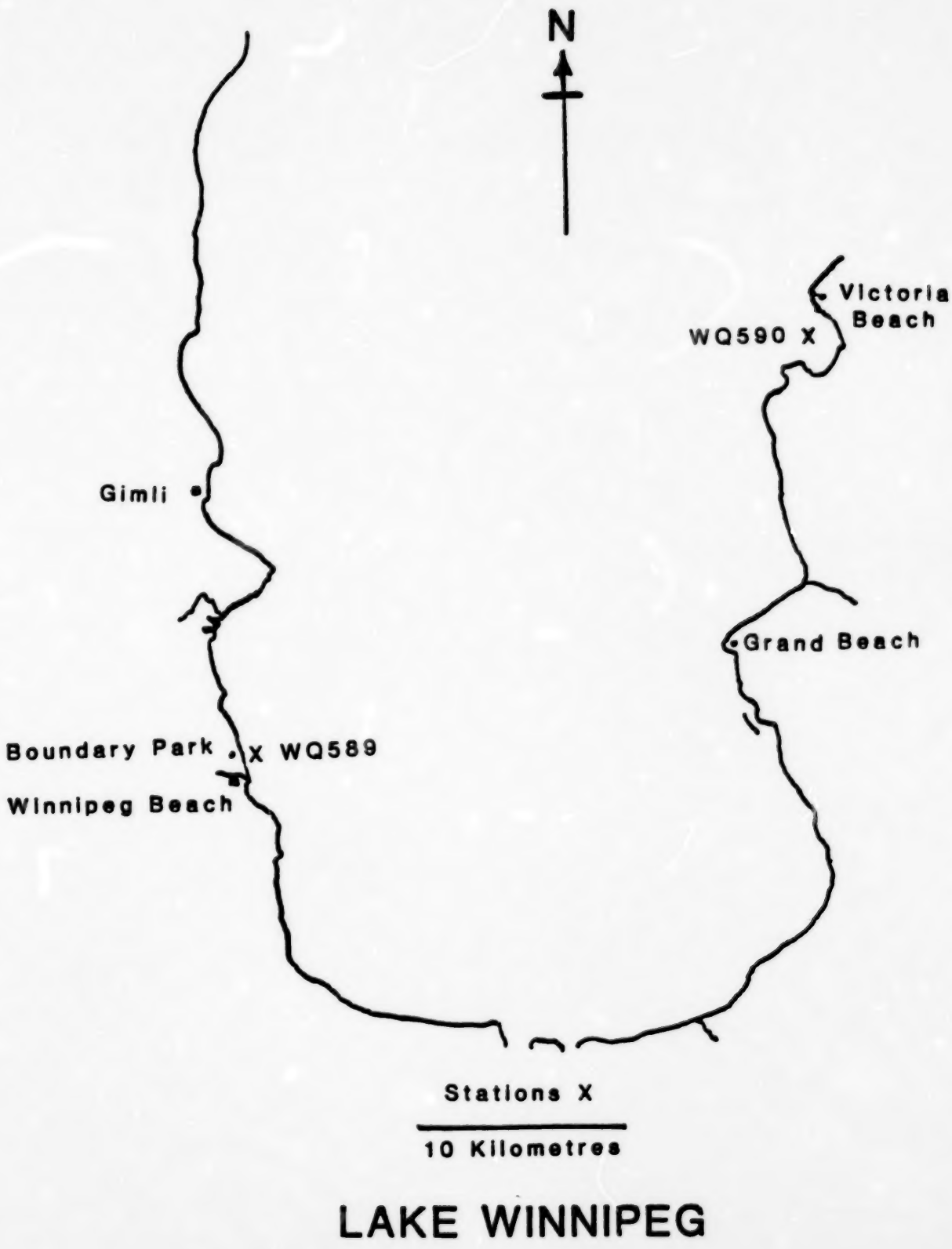

Figure 1. Lake Winnipeg showing water quality stations

RESULTS AND DISCUSSION

Chlorophyll a and Secchi disc data from Lake Winnipeg were collected near Boundary Park in 1980 1981 and 1982 and at Victoria Beach in 1981 and 1982 (Figure 1). Weekly results at Boundary Park and Victoria Beach are presented in Table 1. The mean annual chlorophyll a at Boundary Park was 16.4 ug/l in 1980 and during 1981 the mean annual chlorophyll a rose to 20.1 and 18.4 ug/l at Boundary Park and Victoria Beach, respectively (Figure 2). In 1982 data was collected mainly during July and August at Boundary Park and during May and June at Victoria Beach and therefore there is a considerable difference between the mean chlorophyll a noted at each location. However, it is notable that in both cases, during 1982, the mean chlorophyll a dropped substantially from the previous year to 10.9 and 4.5 ug/l at Boundary Park and Victoria Beach, respectively. This was indicative of a decrease in algae populations to acceptable levels and this was a considerable improvement over nuisance algae noted in 1980 and 1981. At Boundary Park the mean annual Secchi disc values were relatively constant, ranging from 0.5 m to 0.3 m at Victoria Beach the mean annual Secchi disc value was 0.4 and 0.5 m in 1981 to 1982, respectively (Figure 2).

Carlson's (1977) trophic state indicies (TSI) were calculated for mean annual chlorophyll a and Secchi disc results. TSI values for chlorophyll a at Boundary Park fluctuated from 58.0 to 60.0 to 54.0 in 1980, 1981 and 1982, respectively. The TSI for chlorophyll a at Victoria Beach dropped from 59.1 to 45.4 from 1981 to 1982. The chlorophyll a TSI's in 1980 and 1981 indicate that the south basin of Lake Winnipeg is relatively enriched while the 1982 chlorophyll a TSI's showed a moderation in enrichment. This was probably indicative of natural fluctuations in enrichment status. Secchi disc TSI at Boundary Park were 69.7 and 75.8 and 74.6 in 1980, 1981 and 1982, respectively, while the Secchi disc TSI at Victoria Beach were 72.6 and 69.6 during 1981 and 1982, respectively. The high TSI values for Secchi disc over estimate trophic status since they are considerably affected by turbidity due to small particles (silt, etc.) suspended in the water column.

Chlorophyll *a* and Secchi disc results will vary from year to year and further data collection is required to establish long-term trends.

Table 1 - Chlorophyll a (Chlor. a in ug/l) and Secchi disc (S.D. in m) values for Station WQ589 at Boundary Park and Station WQ590 at Victoria Beach on Lake Winnipeg from 1980 through 1982.

Date	Boundary Park Station WQ589		Victoria Beach Station WQ590	
	Chlor. a (ug/l)	S.D. (m)	Chlor. a (ug/l)	S.D. (m)
1980				
June 15	11.4	0.9		
June 22	11.0	1.0		
June 29	31.3	0.3		
July 6	35.2	0.4		
July 10	9.8	0.5		
July 21	17.0	0.3	Not sampled in 1980	
July 24	14.3	0.2		
July 28	8.8	0.6		
Aug. 4	15.6	0.1		
Aug. 11	NA	0.5		
Aug. 29	9.8	0.8		
1981				
June 13	11.5	0.3	-	
June 14	-	-	7.1	0.5
June 20	-	-	6.5	0.1
June 28	4.7	0.3	-	
July 5	11.5	0.4	21.5	0.5
July 12	38.3	0.4	-	
July 13	-	-	22.7	0.5
July 19	-	-	30.0	0.8
July 22	29.0	0.3	-	
July 28	33.0	0.3	-	
Aug. 2	-	-	13.3	0.3
Aug. 3	-	-	9.5	0.1
Aug. 5	19.5	0.5	-	-
Aug. 9	-	-	26.9	NA
Aug. 11	18.4	0.4	-	
Aug. 16	39.0	0.2	6.1	0.8
Aug. 23	28.0	0.2	54.0	0.2
Aug. 30	3.6	0.5	3.2	0.5
Sept. 6	3.4	0.2	-	
Sept. 13	-	-	19.5	0.3
1982				
May 24	-	-	6.4	1.0
May 28	-	-	2.8	0.5
June 6	-	-	2.8	0.4
June 12	-	-	5.3	0.6
June 14	5.9	0.3	-	
June 19	-	-	3.8	0.5
June 27	-	-	4.5	0.4
July 13	13.0	0.3	-	
July 19	11.1	0.4	-	
July 25	8.8	0.6	-	
Aug. 2	9.8	0.5	-	
Aug. 9	12.7	0.2	-	
Aug. 22	15.0	0.3	-	
Sept. 6	11.0	0.3	6.1	0.2

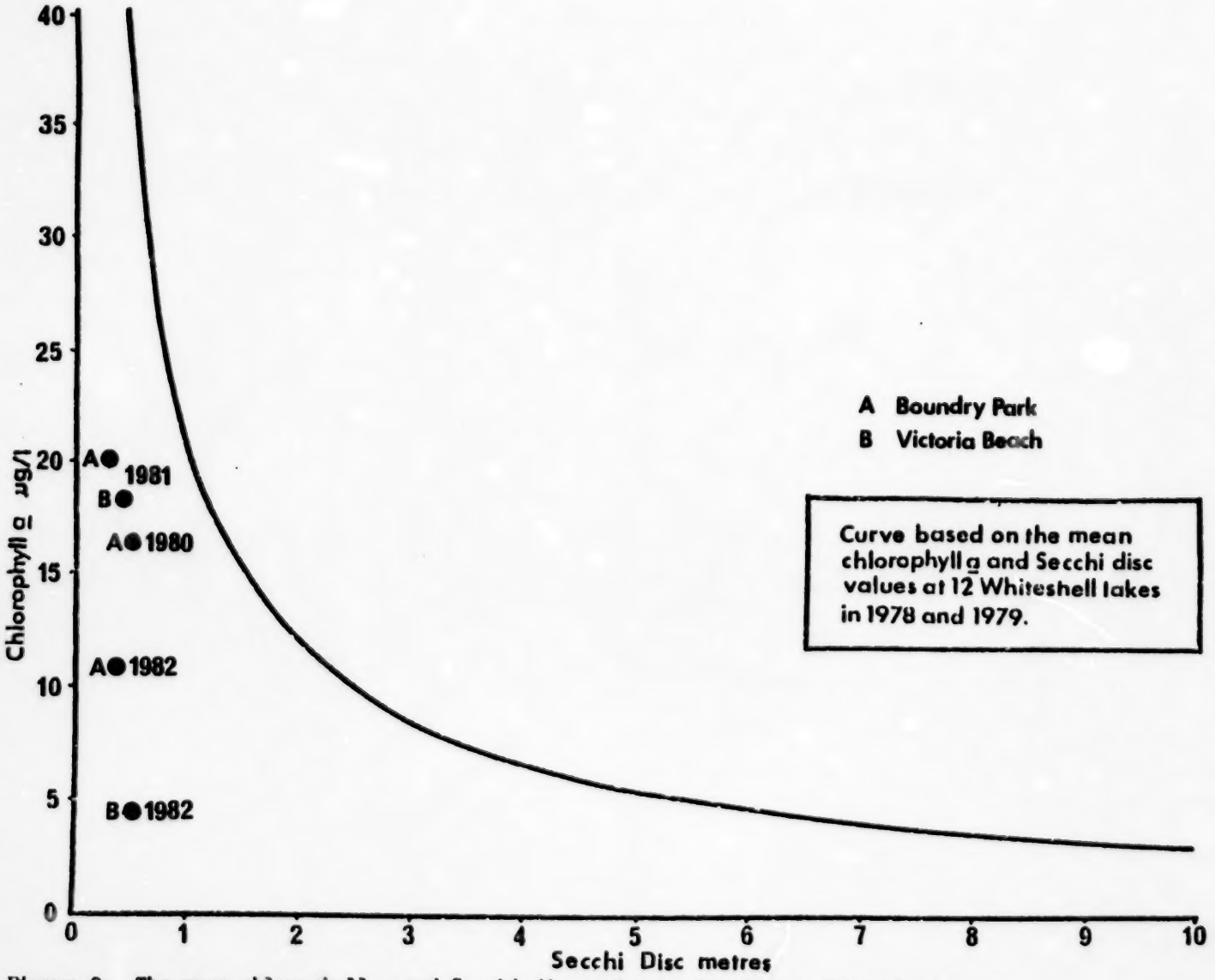

Figure 2: The mean chlorophyll a and Secchi disc values collected on Lake Winnipeg

GLOSSARY OF TERMS

ALGAE - an assemblage of simple, mostly microscopic non-vascular plants containing photosynthetic pigments such as chlorophyll. Algae occur suspended in water (phytoplankton) and attached to rock and other suitable substrates. Some algae may produce nuisance conditions when environmental parameters are suitable for prolific growth.

CHLOROPHYLL - the photosynthetic green pigment which occurs in all groups of algae.

EUPHOTIC ZONE - the lighted region that extends vertically from the water surface to the level at which photosynthesis fails to occur due to insufficient light penetration.

EUTROPHIC - waters containing a rich supply of plant nutrients that support heavy growths of algae and aquatic plants. The increase in algae causes a decrease in the penetration of light. Deep areas may exhibit oxygen depletion due to the decomposition of dead organisms. Eutrophic lakes tend to be shallow and support warm water species of fish. The degradation in water quality renders the lake unsuitable for many recreational activities.

EUTROPHICATION - the process of becoming increasingly enriched in nutrients. It refers to the entire complex of changes which accompanies increasing nutrient enrichment. The result is the production of dense nuisance growths of algae and aquatic weeds which generally degrade water quality and render the lake unsuitable for many recreational activities. Accompanying the increase in algae is a decrease in game fish and an increase in coarse fish.

MESOTROPHIC - waters characterized by a moderate nutrient supply and organic production (i.e. midway between eutrophic and oligotrophic). The waters are suitable for most recreational activities.

OLIGOTROPHIC - waters containing a poor supply of plant nutrients resulting in little algae and aquatic plant growth. The waters are generally clear permitting extensive light penetration. Oxygen in the bottom waters is abundant. Oligotrophic lakes tend to be deep and support cold water fish such as lake trout and whitefish. The lakes are well suited for all types of recreational activities.

SECCHI DISC - a circular metal plate, 20 centimeters in diameter, the upper surface of which is divided into four equal quadrants and so painted that two quadrants directly opposite each other are painted black and the intervening ones white. The Secchi disc is used to estimate the depth of the euphotic zone.

TROPHIC STATUS - depending upon the degree of nutrient enrichment and resulting biological productivity, lakes are generally classified into three intergrading types: oligotrophic, mesotrophic and eutrophic. If the supply of nutrients to an oligotrophic lake is progessively increased, the lakes becomes more mesotrophic in character; with continued enrichment, it will become eutrophic.

µg/l - micrograms per liter or parts per billion.

LITERATURE CITED

CARLSON, R. E. 1977. A trophic state index for lakes. Limnol. Oceanogr. 22(2): 361-369.

Province of Manitoba. 1981. Public Health Act. Revised Regulations P210-R3, Division VII, Section 57.

POOR

QUALITY

ORIGINAL